DESCRIPTION

The present invention relates to the field of container closures, notably the field of pressurised tanks, and more particularly means of opening and closing pneumatic press tanks.

The invention relates to a container door device and a container comprising at least one such device.

An opening in a container such as a cylindrical tank is produced by a break in the continuity of the skin, resulting in a concentration of stresses at the stress absorption points when the door is opened. The connection points between the door and the tank will therefore by highly stressed and thus constitute weak points subject to preferential rupture, limiting the pressures applied.

In practice, the inventors have been able to make various observations and deductions in the aforementioned context.

Thus, any opening in a pressurised tank causes it to collapse and any deformation connected to the take-up of play produces a modification in the initial geometry of the tank, in other words a loss of cylindricity. These deformations are the cause of concentrations of stress that are prejudicial to the strength of the tank and resistance to fatigue.

Many tank (or container) door closure devices are known and used. They comprise slide rails, guiding bars, stiffeners, bolts that take up the connection stresses between the door and the tank locally or when needed. These localised stresses are concentrated and impose relatively large, and therefore costly, dimensions.

The object of the invention in particular is to reduce the aforementioned disadvantages. Its object is also to provide a simple door structure with low manufacturing cost, while avoiding as far as possible the formation of structural discontinuity and weak points.

Accordingly, the invention relates to a door device for a container, preferably cylindrical, comprising at least one casing portion that is curved or bent in section, and an opening made in this portion to be closed by said door device, which device is characterised in that it consists principally, on the one hand, of two rectilinear profiled elements parallel to each other, fixed or formed on the external face of the casing on both sides of the opening or in the region of the edges thereof and, on the other hand, of at least one element in the form of a plate having a curvature resembling that of the casing portion containing the opening and comprising two opposite edges each provided with a profiled longitudinal structure, of which the section permits retention or engagement in one of said profiled elements and allows continuous sliding therein, these profiled elements thus forming positive connection means and slide rails over the whole length for said element(s) in the form of a plate and guiding it (them) between a closed position of the opening and a disengaged or released position thereof.

The invention will be better understood, using the description below, which relates to preferred embodiments, given as non-limiting examples, and explained with reference to the accompanying diagrammatic drawings, in which:

Fig. 1 is a view in perspective of a door device in the closed state, according to a first variant of a first embodiment;

Fig. 2 is a view in side elevation of the door device in Fig. 1;

Fig. 3 is a view in section along A-A of the door device in Fig. 2;

Fig. 4 is a view on a different scale of the detail B of Fig. 3;

Fig. 5 is a view in side elevation and on a different scale of a detail of Fig. 1;

Fig. 6 is a view in side elevation of a door device according to a second variant of a first embodiment of the invention;

Fig. 7 is a view on a different scale of the detail C of Fig. 6;

Fig. 8 is a view in section on a different scale of a sliding connection between a profiled element forming a slide rail and a profiled structure attached to an element in the form of a plate, according to a second embodiment of the invention;

Fig. 9 is a view in perspective of a door panel made up of several elements in the form of a plate forming part of a door device according to the invention;

Fig. 10 is a view similar to that in Fig. 4, according to another variant embodiment;

Fig. 11A is a view in partial perspective of a door device according to another variant of the invention, comprising two elements in the form of a plate;

Fig. 11B is a view in section on a different scale of the detail E of Fig. 11A, and,

Figs. 12A and 12B are views in partial section showing two alternative ways according to the invention of connecting the door panel(s) and the container casing by slide rail.

As shown in the figures of the accompanying drawings, the door device 1 consists principally, on the one hand, of two profiled rectilinear elements 4 and 4' parallel to each other, fixed or formed on the external face of the casing on both sides of the opening 3 or in the region of the edges thereof and, on the other hand, of at least one element in the form of a plate 5, 5' having a curvature resembling that of the portion 2' of the casing 2 containing the opening 3 and comprising two opposite edges 6 and 6' each provided with a longitudinal profiled structure 7, parallel to each other, of which the section permits engagement or retention in one of said profiled elements 4, 4' and allows continuous guided sliding therein, these hollow elements 4, 4' thus forming positive connection means and slide rails over the entire length for said element(s) 5, 5' in the form of plate(s) and guiding it (them) between a blocked or closed position of the opening 3 and a disengaged or released position (preferably total) thereof.

Thus, by continuously taking up the stresses over the whole length of the opening, the invention proposes to dilute and distribute these stresses, and this allows the door closing

device to be reduced considerably in size and simplified structurally.

According to a first characteristic of the invention, the bent element or each bent element in the form of a plate 5, 5' can be at least slightly deformed under pressure and can have at least two states corresponding to two different radii of curvature, the greater of the two radii of curvature allowing a movement in translation of the element 5, 5' concerned and the smaller of the two radii of curvature allowing locking in position of said element 5, 5' concerned, the smaller of the two radii of curvature being at least slightly greater than the radius of curvature of the portion 2' of the casing comprising the opening 3.

According to a first embodiment, that enables any deformation to be avoided when pressure rises in the container, the or each element in the form of a plate 5, 5' is mounted without play and under tension in or on the profiled elements 4 and 4' forming slide rails, in such a way that a deformation of this element 5, 5', causing an increase in its radius of curvature, is necessary to allow it to move by sliding, said element 5, 5' not being substantially deformed when the container is put under pressure.

In a variant and according to another possible embodiment, the or each element in the form of a plate 5, 5' is mounted with play and free to slide in the profiled elements 4, 4' forming slide rails, the application of pressure to the container causing a deformation of said element(s) 5, 5' with a reduction of its radius of curvature and immobilisation in translation in relation to said profiled elements 4 and 4'.

The assembly clearance of the element(s) 5, 5' forming the door corresponds to the clearance necessary to its operation (sliding), and it is when pressure is applied that the play will be taken up by the change in curvature of the door (elements 5, 5'). In this case, the radius of curvature of the door at rest (with clearance) is greater than that of the door in the taut position, in other words, the door in contact with the slide rail and play eliminated. Under this principle, it is the pressure applied in the container that modifies the radius of curvature of the door. The end result is the same as in the first aforementioned case, that is, that the radius of curvature of the door is always greater than that of the tank.

In fact, in the two cases mentioned above, there are only two positions for the door (element 5 or elements 5, 5'), which are:

- a position in contact, with play, with a large radius of curvature

- a taut position (or position without play) with a working radius of curvature: resembling that of a ring but always greater.

In a decidedly preferred manner, and as shown in Figs. 3, 4, 5, 6, 8 and 10, the connections between the profiled longitudinal structure 7 and the respective profiled element 4, 4' are configured in such a way that the resulting indentations between the edges of the opening 3 and the edges 6, 6' of the element(s) in the form of a plate 5, 5' opposite each other are not deep.

The proximity of the door and container skins (see particularly Fig. 3) reduces discontinuity and the level of stresses and corresponding deformations. The same applies to the position of the stress absorption points. In fact, the closer the geometry of the door is to the geometry of the portion of the container receiving it, the lower will be the stresses and deformations.

In addition, an increase in the number of stress absorption points between the door and the container casing allows the stress level at each of these points to be reduced, and they can therefore be sized more appropriately, thus reducing the distance between door and container.

The stress absorption produced by the aforementioned principle allows the door device to be reduced to its simplest expression: a single plate (or a plurality of plates) with a curvature similar to that of the ring of the portion 2' of the container casing is enough. In fact, the slide rail principle allows the container and the door to be worked as a diaphragm, in other words under tension and not under flexion.

According to a first embodiment of the invention, illustrated in Figs. 1, 3, 4 to 7 and 12 of the accompanying drawings, each sliding connection [profiled structure 7/profiled element4,4'] consists of a solid profiled or encased connection sliding in a hollow or enveloping profile provided with a longitudinal slot 4''.

As shown in the aforementioned figures, the solid profiles, formed in a single piece with the element in the form of a plate or the casing or attached by welding on one of these (depending on the variant used), are in close surface contact

with longitudinal portions 10, 10' of the internal faces of the walls of the hollow profiles extending on both sides of their respective longitudinal slots 4'', when the element in the form of a plate 5, 5' concerned has its smallest radius of curvature.

The surface contact zones will have forms that depend on those of the hollow profiles and the solid profiles or thickenings in contact, in other words for example flat (Figs. 6 and 7) or partially circular cylindrical (Figs. 3 to 5 and 12).

In the latter case, the cylindricity and concentricity of the profiles in contact allows adjustment, when pressure is applied, of the door in relation to the tank. This system permits slight rotations of the door on the container or tank so as to work as a diaphragm.

The openings of the slots 4'' of the hollow profiles are turned substantially towards one another or opposite each other along planes parallel to the planes tangential to the casing 2 at the fixing places of said profiles 4, 4'.

Thus, the element(s) 5, 5' can only move after the surface zones in contact with the solid profiles or thickenings of the internal face portions 10 and 10' have been separated by modifying the radius of curvature of the element(s) 5, 5'.

This modification may possibly be produced by an independent external means, by modification of the internal pressure of the container or by a means attached by the door device 1.

Practically, the profiled elements 4 and 4' may consist of hollow profiles each comprising a longitudinal opening in the form of a slot 4'' and be attached directly on the external

face of the casing 2 of the container, being fixed for example by welding, and the parallel profiled structures 7 may consist of thickenings of the edges 6, 6' of each element 5 in the form of a plate (Figs. 1, 4, 5, 6, 7 and 12A).

In a variant, it may also be provided that the profiled elements 4, 4' consist of thickenings or solid profiles attached or formed in the region of the opposed edges of the opening 3 and in that the parallel profiled structures 7 consist of hollow profiles each comprising a longitudinal slot-shaped opening 4'' formed or attached on the respective edges 6, 6' (Figs. 10 and 12B).

According to a second embodiment, illustrated diagrammatically in Fig. 8 of the accompanying drawings, the profiled elements 4, 4' and the profiled structures 7 may in cross-section have profiles in the form of hooks, able to engage with each other, one of the hooks delimiting a groove 16 which receives the end of the other hook, optionally provided with a thickening 17.

To reinforce the resistance of the profiled elements 4, 4' to being pulled out, while at the same time distributing the stresses over a larger area of the casing 2, each profiled element 4, 4' may be connected to the casing 2 by a longitudinal connection element 8, such as for example a band or elongated plate, and optionally by at least one stress absorption part 9, extending in a plane substantially perpendicular to the longitudinal direction of the profiled element in question 4, 4' and connected to the casing 2 on a portion of its perimeter.

As already indicated, if the element or elements 5, 5' in the form of a plate is (are) assembled without play and with

immobilisation in translation in the profiled elements 4, 4' forming slide rails, modification of the curvature allowing the sliding movement may be obtained by different means.

However, preferably, as shown in Fig. 6, each element in the form of a plate 5, 5' carries on its external face a controlled curvature deformation device 11, of which the action on said element 5, 5' causes a gap at its two opposed parallel edges 6 and 6'.

According to an advantageous embodiment, the or each deformation device 11 comprises a support component 12 that can be moved perpendicular to a plane tangential to the bent element 5, 5' in the form of a plate concerned and mounted in a support and guiding structure 13 applied against said element 5, 5' in the form of a plate by symmetrical stress absorption elements 13, fixed on the element concerned 5, 5' close to its opposed parallel lateral edges 6 and 6', the support component 12 being integral with an operating component 12' that also allows the sliding movement of the element 5, 5' concerned.

The operating component 12' may for example consist of a rotating handle, the support component 12 being in the form of a threaded rod mounted in a threaded holder forming part of the support and guiding structure 13.

Preferably, the container has a cylindrical structure of circular section, its casing 2 and the bent element(s) 5, 5' in the form of a plate are produced in sheet metal, preferably in stainless steel sheet metal and the opening 3 advantageously has a substantially rectangular shape.

The element for closing the opening 3 (the door panel) may also be produced in several versions.

Thus, the door device 1 may comprise a single element 5 in the form of a plate produced in a single piece.

In a first alternative solution, illustrated in Fig. 9, the door device 1 may comprise a single element 5 in the form of a plate, consisting of several adjacent portions in sheet metal connected to each other by flexible connections 14, which are preferably sealed, for example in the form of portions of bands made of a flexible synthetic material. These flexible connections allow construction and assembly play to be absorbed.

In a second alternative solution, and as illustrated in Fig. 1 of the accompanying drawings, the door device 1 may comprise two elements 5 and 5' in the form of independent bent plates, of which the mutually adjacent edges in the closed position of the opening 3 may comprise closing devices, optionally mutually cooperating sealing devices.

The invention also relates to a container, in particular a pneumatic press tank, characterised in that it comprises a door device 1 as described above.

When the profiled elements 4, 4' are arranged recessed in relation to the opposite edges of the casing 2 defining in part the opening 3, the face of the edges 6, 6' of the element(s) in the form of a plate 5, 5' situated opposite the casing portion 2' may be provided with a packing 15 which is preferably inflatable, extending over the whole perimeter of the element 5, 5' concerned.

As a variant, it may also be provided that the casing portion 2' comprising said opening 3 be equipped with a packing which is preferably inflatable, extending round said opening 3.

When the door device 1 consists of two elements in the form of a plate 5 and 5', the opening 3 may be provided with a middle rail 18, for example with a T section, providing support surfaces 19 to the adjacent devices in the closed position of the elements 5 and 5', for example in the form of a portion of inflatable packing 15 (Figs. 11A and 11B).

Of course, the invention is not limited to the embodiments described and illustrated in the accompanying drawings. Modifications are still possible, in particular from the point of view of the composition of the various elements or by substitution of technical equivalents, without thereby departing from the scope of protection of the invention.